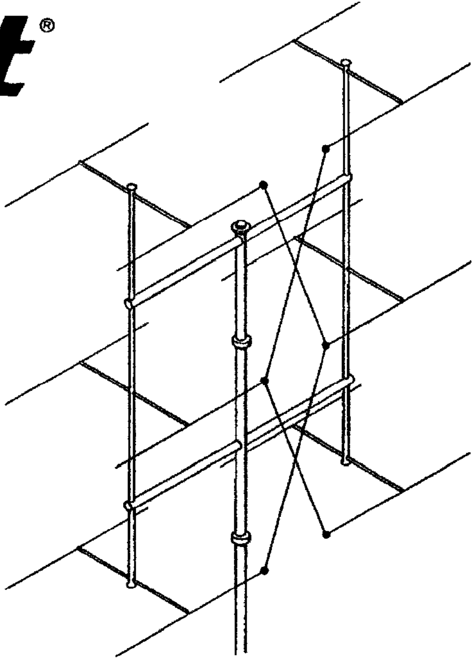
knight®

T-175 6/10
METER LINEAR
AMPLIFIER



OPERATOR'S MANUAL

SPECIFICATIONS

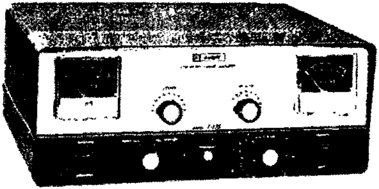
FREQUENCY RANGE:	6, 10, and 11* meter bands (6m and 10/11m coils supplied.) 27-30 mhz; 50-54 mhz
INPUT IMPEDANCE:	50 ohms nominal
DRIVE REQUIREMENTS:**	AM Linear: 1 to 4 watts. AM Plate Modulated: 1 to 4 watts. CW: 7 watts. SSB: 15 watts PEP max.
PLATE POWER INPUT:***	AM Linear: 120 watts max. AM Plate Modulated: 120 watts max. CW: 150 watts max. SSB: 300 watts PEP max.
CLASS OF OPERATION:	B_2 Grounded Grid.
OUTPUT IMPEDANCE:	50 to 70 ohm Pi matching network. VSWR 3:1 or less.
PRIMARY INPUT:	110-130 VAC, 60 hz, 220 watts max., 45 watts standby.
METERS (2):	Plate Current and combination Grid Current/Relative Power.
COOLING:	Forced air (FAN) during transmit. Thermal radiators on Plate caps.
POWER SUPPLY:	Fullwave voltage doubler high voltage supply. Halfwave voltage doubler bias supply.
TUBE COMPLEMENT:	(2) 6JE6A output amplifiers. (1) 12AT7 relay amplifier.
SIZE:	5½ x 13⅛ x 11" (HWD)
WEIGHT:	20 lbs.

*Illegal in the United States.

**50Ω, 5-watt swamping resistor supplied for operation with higher power exciters.

***Actual input depends on input drive level.

CONTROL FUNCTIONS



Meter, GRID MA — monitors the amount of current to the grids of the two output tubes. Also serves as a relative power output indicator, which is used during loading and adjusting the amplifier.

LOAD — matches the output of the linear to the antenna. It can be used to match antenna impedances of 30 to 90 ohms, providing the VSWR is 3:1 or less.

PLATE — is used to resonate the plate circuit of the linear at the exciter operating frequency.

OPERATE/STANDBY — In the OPERATE position, the linear is ready to operate when the exciter is functioning. In the STANDBY position, the exciter operates in the "barefoot" mode.

GRID MA/REL POWER SWITCH — in the GRID MA position, reads the current on the grids of the two output tubes. In the REL POWER position, the relative output power can be read.

GRID BIAS — varies the grid voltage applied to the two output tubes.

POWER/OFF — turns the power on and off

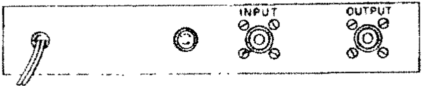
Meter, PLATE MA — monitors the plate current of the two output tubes

FUNCTIONS ON THE REAR OF THE CHASSIS

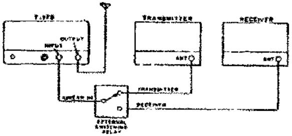
FUSE: The fuse used in your linear amplifier is a 2-amp, slo-blo type. If replacement is necessary, use only an exact replacement.

INPUT: Attach the coaxial cable from your transceiver to this connector.

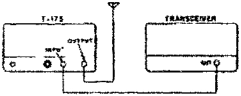
OUTPUT: Attach the coaxial cable from your antenna system to this connector.



OPERATIONAL CONSIDERATIONS



USING THE T-175 WITH A SEPARATE TRANSMITTER/RECEIVER



USING THE T-175 WITH A TRANSCEIVER

Although the T-175 is simple to tune up, requiring only adjustments of the plate tuning and loading as indicated by the two meters, certain precautions must be observed if maximum performance is to be realized.

The T-175 requires from 1 to 4 watts drive power for linear operation. If the maximum drive power is available (4 watts) from the exciter, care must then be exercised that the linear is not overloaded, resulting in non-linear operation. If the drive power is less than 4 watts, though, the full output power from the exciter can be used for proper linear operation.

Proper operation does not occur with maximum RF output. The unit will deliver the specified power output when tuned as instructed. The quality of the signal will be good, too. But more RF output can be obtained by improper tuning which results in a distorted, non-linear signal.

In addition to AM linear operation, the unit can be used for CW and Single Side Band operation. Tune-up for these modes is not as critical as for AM linear operation. The significant difference is that tune-up in these modes is for maximum RF output.

Serious damage can occur to your linear amplifier if you operate without a load. Do not use an antenna as a load on 6 or 10 meters unless you are a licensed amateur radio operator. A shielded dummy load is recommended for tune-up procedures. This will minimize the interference on the air. Keep all inter-connecting cables short. = MIN. 3 FT

This unit is illegal for Class D, 11 meters (CB) operation in the United States.

CHANGE IN METER READINGS WITH A CHANGE IN DRIVE POWER

GRID CURRENT (Ma)	4	6	8	10	12
PLATE CURRENT (Ma)	115	125	135	145	150
PLATE CURRENT (Linear)Ma	130	145	155	170	175
RELATIVE POWER	7	8.5	9	10	10.5
APPX CARRIER POWER OUT (Watts)	20	26	30	36	40

Your linear is designed so that you can operate your exciter without the inconvenience of disconnecting it from the linear:

☐ Turn the exciter power on, or place the STANDBY/OPERATE switch in the STANDBY position.

☐ Turn the linear power off.

☐ Tune-up your exciter in the prescribed manner. If your exciter is known to be good but you do not get output power to the antenna, then check the wiring of the K-1 relay in the linear.

AM LINEAR OPERATION

This amplifier requires an exciter which is capable of delivering from 1 to 4 watts drive power for both tune-up and AM operation. If your exciter's minimum output is greater than the specified drive power, then its output must be controlled by the addition of a swamping resistor which is included with your unit. See dotted line (R-7) on the schematic.

☐ Place the linear OPERATE/STANDBY switch in the STANDBY position.

☐ Set the POWER/OFF switch to the POWER position.

☐ Allow the linear to warm up for 1 minute. CAUTION: the plate current should not rise above 30 ma. If it does, disconnect the power immediately and inspect for a wiring error.

☐ Set the GRID BIAS control to approximately its mid-range position. NOTE: The adjustment is not critical.

☐ Set the linear PLATE and LOAD controls to 5.

☐ Set the GRID MA/REL POWER switch to the REL POWER position.

☐ Tune-up your transceiver in the prescribed manner.

☐ Set the linear OPERATE/STANDBY switch to the OPERATE position.

☐ Activate the transceiver TRANSMIT switch and adjust the PLATE and LOAD controls on the linear for a maximum reading on the REL POWER meter.

☐ If the REL POWER indication exceeds 11 (eleven), adjust the transceiver LOAD and PLATE tuning controls until the meter reads 11. In reducing the output of either the transceiver or linear, the PLATE control must always be peaked afterwards.

NOTE: If you are unable to make the above adjustment, then the swamping resistor R-7 must be used.

☐ Record the REL POWER reading. For simplicity, lets say it is 10.

☐ Now rotate the linear LOAD control clockwise and peak the PLATE control until there is a 10% reduction in the REL POWER meter reading (9 in our example).

☐ Turn the GRID MA/REL POWER switch to the GRID MA position and record the grid current on the GRID MA meter. Record, also, the reading on the PLATE MA meter. Future tune-up will be much easier if you keep these readings in mind.

☐ You are now ready for AM linear operation.

CW OPERATION

If you use a keyer for CW and your operating speed is greater than 12, you must energize the K-1 relay. This can be accomplished by substituting a 270 Ω resistor for R-3.

☐ Tune the amplifier in the same manner as for AM linear, following steps 1 through 9.

☐ The REL POWER reading will depend on the amount of drive power from the exciter. Under no conditions should the linear be driven to more than 75 watts output (210 ma). At 75 watts, the grid current may be greater than 20 ma.

☐ You are now ready for CW operation.

SSB OPERATION

Tune-up for SSB should always be performed while using a modulation scope. Many helpful hints are contained in the ARRL Amateur Radio Operators Handbook.

HIGH LEVEL RF AMPLIFIER

The T-175 can be used as a high-level, plate modulated RF amplifier. 60 watts of audio power will be required with the plate current limited to 150 ma.

CIRCUIT DESCRIPTION

The T-175 operates as a grounded-grid, class B, RF linear amplifier with 120-watts input power for AM linear operation and plate modulation, 150-watts input for CW and 300-watts PEP for single side band. The power supply and antenna change over relay are within a single enclosure.

A linear RF amplifier is distinct from a class C RF amplifier in that the linear amplifies the signal after it is modulated, not before. The output from the linear must, therefore, be proportional to the input, otherwise distortion will result.

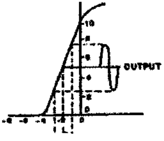
To illustrate, refer to the diagram below. The term linear comes from a graphical representation of the voltage/current relationship in a vacuum tube. If you plot this relationship on a graph, you will see that at a certain point an increase in grid voltage will not result in an increase in plate current, thus non-linear response. In the illustration below, the input signal is well within the linear capabilities of the tube, and the output signal is proportional to the input signal. The only difference being in magnitude.

Two things can cause non-linear response. The grid bias on the tube used in our illustration is 5 volts, but if the grid bias were changed to 2 volts, distortion would occur since the negative half of the output signal would swing below the linear capabilities of the tube. Additionally, non-linear response could occur if the input signal were too large. A large input signal could drive the negative and positive half of the output signal well beyond the linear capabilities of the tube, again resulting to distortion.

For proper linear operation, therefore, the amplifier must (1) never be loaded-up to its maximum capabilities—that is, with maximum current flow in the plate circuit; (2) equally important, the drive signal from the exciter must never be such that it over drives the linear.

INPUT CIRCUIT

The two 6JE6A vacuum tubes, connected in parallel, operate in grounded-grid circuitry. RF drive from the exciter is applied through capacitor C-4 to the tubes cathodes which are connected to ground through a 7 uhy RF choke.



If the exciter output is greater than the specified drive requirements for the linear, the RF drive is then applied directly to resistor R-7, which limits the voltage delivered to the cathodes of the output tubes.

The low impedance of the input circuit presents a constant load to the exciter. This lessens the possibility of non-linear response due to poor exciter regulation. Also, this low impedance grid to ground circuit eliminates the need for neutralization and results in stable operation under all operating conditions.

A sample of the RF drive is taken from the input circuit and applied to the detector diode CR-1 and then fed into the grid of V-1, a relay amplifier. Relay K-1 is then energized only when the linear is in the OPERATE mode. During STANDBY mode the amplifier is run barefoot and the relay is not energized.

OUTPUT CIRCUIT

The plate circuit of the two 6JE6A tubes is a conventional pi-network. High plate voltage is applied through the choke coil, RFC-2. The output circuit is isolated from this plate voltage by blocking capacitor C-7. If C-7 breaks down, though, RFC-3 will short the B+ to ground and blow the fuse, preventing B+ from appearing on the antenna. The PLATE tune capacitor (C-11) resonates the plate circuit of the transmitter final amplifier at the operating frequency. The load capacitor (C-12) permits matching loads from 50 to 75 ohms with a VSWR of 3:1 or less.

METERING

A 0-250 ma DC meter connected in series with the high voltage line provides continuous plate current measurement. A separate 0-20 ma DC meter connected in parallel with a 51-ohm shunt resistor provides for continuous grid current monitoring or relative power output monitoring.

GRID BIAS

The bias circuit is a half-wave voltage doubler which provides a small negative DC voltage to the grids of the two 6JE6A tubes. The grid bias is adjusted through R-13.

POWER SUPPLY

The power transformer, T-1, has a single primary winding and two secondary windings. The filament winding provides a source of power for the three tube filaments and the biasing circuit.

The plate winding provides high B+ through the voltage doubler, CR-5 and CR-6, to the plates of V-2 and V-3. In addition, low B+ is applied to the plate of the relay amplifier, V-1.

MAINTENANCE

CAUTION Your linear operates at high voltages which can cause injury to you if you are careless. You should, therefore, not operate it outside of the cabinet. But if you must do so, place some kind of protective paper over the braided wire attached to the tubes on top of the chassis.

Under normal conditions, the T-175 will given many years of trouble-free service. Because the unit is ventilated by a fan, dust may accumulate on the switches and other associated components within the enclosure. The unit should, therefore, be removed from the cabinet and cleaned twice a year. Vacuuming is an acceptable method for cleaning.

Additionally, the relay contacts should be cleaned periodically. Even during normal operation the relay contacts may burn or pit. They should be cleaned with the finest grit sandpaper. Do not use emery or crocus cloth. After sandpapering the contacts, clean thoroughly with alcohol or a similar cleaning agent.

Twice a year a drop or two of light oil should be applied to both bearings of the fan motor.

TROUBLESHOOTING

SYMPTOM	SERVICE PROCEDURE
Arcing in plate tank components	Antenna mismatch. Try changing feedline length.
No plate voltage	Check wiring of T-1. Check polarity of CR-5 and CR-6.
Output distorted	Linear overdriven or underloaded. Review tune-up procedure.
Insufficient loading range	High VSWR reading
Fuse keeps blowing	Check C-18, 20, 21 and C-7
Relay chatters	Input drive too low. Check V-1 and CR-1 for defect.
Tank circuit approaches resonance with C-11 fully open (min capacity)	Remove one turn from L-1.
Tank circuit approaches resonance with C-11 closed (max capacity)	Place a 5 pf capacitor in parallel with C-11.

TELEVISION INTERFERENCE

Operation on the amateur VHF bands results in the greatest frequency of TVI complaints, as compared to the more popular low frequency bands.

Even though you handled all TVI complaints to the satisfaction of your neighbors, you must remember that you will now be increasing your power by 10 times. If you have been operating without complaints, or have handled all the complaints prior to using the linear, the following hints will help you track down TVI problems if they occur.

Although 90% of all complaints are not the fault of the operator, the first basic rule for every amateur is to keep your own signal clean. Assuming your linear is built properly, the next solution in having a good clean signal is to use a low-pass filter at the output of the linear. Use a filter with a sharp-cut off frequency of 52 to 58 mhz.

A non-technical aspect in your TVI hunt will be the relationship of you the operator to the complainant who is probably not in an amiable frame of mind after being deprived of his favorite TV program. What to do? Explain to him, tactfully of course, that the problem is probably in his receiver. Ask him to help you conduct tests to determine the cause of the TVI. In fact, show him that your television set is not upset by your transmissions. Chances are he will be intrigued by your hobby and want to know more about it.

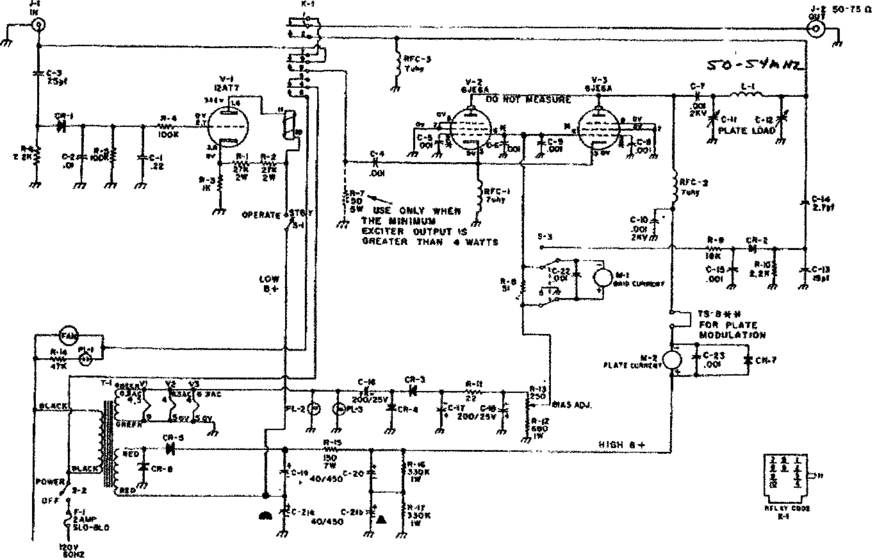
Design deficiencies in the front end of TV sets are the cause of most TVI complaints. Many TV manufacturers recognize this problem and will, upon request, send a high-pass filter to the owner without charge. If the owner prefers, suggest that he purchase a high-pass filter such as the Drake TV-300-HP or an equivalent filter.

RESISTANCE CHART

TUBE	PIN NUMBER								
SYMBOL	1	2	3	4	5	6	7	8	9
V - 1	60K	100K	1K	0	0	60K	100K	1K	0
V - 2 and V - 3	0	1K	0 5	0	0	1K	0	0	N/C

N/C — no connection.

Resistance readings taken with a VTVM with respect to chassis ground. GRID BIAS control set fully counter-clockwise



* VOLTAGE MAY VARY BETWEEN -10 TO -15 V, DEPENDING UPON THE GRID BIAS CONTROL SETTING

** MEASURE B+ AT THIS POINT, TWO VOLTS

NOTES: UNLESS OTHERWISE STATED, ALL CAPACITORS ARE IN MFD. ALL RESISTORS ARE IN OHMS ± 10%, 1/2 WATT

RELAY IS IN AN UNENERGIZED POSITION

S-3 IS IN THE GRID MA POSITION

VOLTAGES ARE ± 20%

SCHEMATIC DIAGRAM FOR T-175 LINEAR AMPLIFIER

PARTS LIST

CAPACITORS

All capacitors are ceramic disc, 20% tolerance, 500-600 volt, unless otherwise specified. Given voltage ratings are the minimum allowable. Capacitors supplied may have a higher voltage rating.

Symbol	Description	Part No.
C-1	.22 µf, 250-volt, mylar	299-083
C-2	.01 µf	276-018
C-3	7.5 pf, 10% NPO	276-072
C-4	.005 µf	276-019
C-5	.001 µf	276-016
C-6	.001 µf	276-016
C-7	.001 µf, 2KV	276-016
C-8	.001 µf	276-018
C-9	.001 µf	276-016
C-10	.001 µf, 2KV	276-016
C-11	PLATE, tuning	286-108
C-12	LOAD, antenna	286-109
C-13	15 pf, 10% NPO	286-028
C-14	2.7 pf, 10% NPO	296-024
C-15	.001 µf	276-016
C-16	500 µf, 25-volt, electrolytic	280-057
C-17	500 µf, 25-volt, electrolytic	580-057
C-18	500 µf, 25-volt, electrolytic	380-057
C-19	40 µf, 450-volt, electrolytic	205-400
C-20	40 µf, 450-volt, electrolytic	205-400
C-21	40/40 µf, 450-volt, electrolytic	248-151
C-22	.005 µf	296-016
C-23	.001 µf	276-016

COILS

Symbol	Description	Part No.
L-1	6-Meters	152-172
L-2	10/11-Meters	152-173
RFC-1	7 µh choke	393-191
RFC-2	7 µh choke	162-191
RFC-3	7 µh choke	162-191

CONNECTORS

J-1	INPUT, coaxial	502-222
J-2	OUTPUT, coaxial	502-223

DIODES

CR-1	germanium (equivalent type 1N277)	630-016
CR-2	germanium (equivalent type 1N277)	630-020
CR-3	Silicon 100 PIV, 750 ma	623-054
CR-4	Silicon 200 PIV, 750 ma	623-004
CR-5	Silicon 1000 PIV, 200 ma	650-004
CR-6	Silicon 1000 PIV, 500 ma	650-004
CR-7	Silicon 120 PIV, 750 ma	623-054

FUSE

F-1	2-amp, SLO-BLO, 3AG	401-004

LAMPS

PL-1	Transmit neon lamp with clip	642-000
PL-2	#47 bulb	640-050
PL-3	#47 bulb	640-002

METERS

M-1	GRID MA	630-007
M-2	PLATE MA	650-205

RELAY

K-1	3 PDT (10K coil)	395-057

RESISTORS

Resistance in ohms. All resistors are ½-watt, 10% carbon composition, unless otherwise specified.

Symbol	Description	Part No.
R-1	27K, 2-watt	307-273
R-2	27K, 2-watt	307-273
R-3	1K	301-102
R-4	100K	301-104
R-5	100K	301-104
R-6	2.2K	301-222
R-7*	50, 5-watt, 5%, metalized film	230-009
R-8	51, 5%	302-510
R-9	10K	301-103
R-10	2.2K	301-222
R-11	22	301-220
R-12	680, 1-watt	288-681
R-13	GRID BIAS Control, 250-ohms, 1-watt	092-248
R-14	47K	301-473
R-15	150, 7-watt	273-014
R-16	330K, 1-watt	304-334
R-17	330K, 1-watt	304-334

SWITCHES

S-1	DPDT, rocker, red; POWER/OFF	431-152
S-2	DPDT, rocker, black; Operate/Standby	401-159
S-3	Rotary; GRID MA/REL POWER	431-166

TERMINAL STRIPS

TS-1	2-terminal	440-201
TS-2	2-terminal	440-222
TS-3	6-terminal	440-604
TS-4	2-terminal	401-201
TS-5	3-terminal	440-303
TS-6	1-terminal	440-101
TS-7	4-terminal	440-403
TS-8	2-terminal	440-205
TS-9	3-terminal	440-301
TS-10	5-terminal	440-501
TS-11	4-terminal	440-403

TRANSFORMER

T-1	Power transformer	207-318

TUBES

V-1	12AT7	621-013
V-2	6JE6	614-353
V-3	6JE6	614-353

HARDWARE

Description	Qty.	Part No.
Clip Nut	(2)	534-706
Lockwasher, #6	(9)	582-200
Lockwasher, #8	(37)	582-300
Lockwasher, #8	(4)	582-400
Lockwasher, #10	(2)	582-500
Lockwasher, ⅜"	(9)	582-701
Nut, 4-40	(10)	570-223
Nut, 6-32	(25)	570-340
Nut, 8-32	(4)	570-440
Nut, ⅜"-32	(8)	570-840

*Not used in assembly. See operator's manual.

HARDWARE

Description	Qty.	Part No.
Screw, 4-40 x ¼"	(20)	580-222
Screw, #4 x ¼" sheet metal	(8)	582-205
Screw, 6-32 x 3/16"	(2)	580-341
Screw, 6-32 x 5/16"	(28)	580-343
Screw, 6-32 x ⅜"	(8)	580-344
Screw, #6 x 5/16" sheet metal	(2)	582-393
Screw, 10-32 x ⅜"	(2)	564-344
Solder lug, large	(1)	553-002
Solder lug, small	(13)	553-005
Washer, flat, ⅜"	(2)	580-702

MISCELLANEOUS

Description	Qty.	Part No.
Bracket, for fan motor	(1)	470-872
Bracket, for tuning capacitors	(1)	470-873
Bushing, ⅜-32 x ¼"	(2)	470-308
Bushing, line cord	(1)	800-031
Case top	(1)	702-126
Case bottom	(1)	702-127
Ceramic standoff, ¾"	(2)	940-051
Ceramic standoff, 2"	(1)	940-052
Chassis	(1)	403-652
Clip for tube plate connection	(2)	504-193
Fan	(1)	085-009
Fuse holder	(1)	092-000
Grommet, ¼"	(1)	830-001
Grommet, 5/16"	(4)	830-004
Grommet, ⅜"	(2)	830-002
Heat-sink	(2)	405-013
Knob, with white dot	(3)	765-074
Knob, no dot	(1)	765-085
Lacing twine, 24"	(1)	800-028
Motor	(1)	085-000
Panel, front	(1)	403-653
Rubber feet	(4)	821-001
Shield, base	(1)	511-054
Shield, tube	(2)	511-063
Socket, 9-pin tube (small)	(1)	501-092
Socket, 9-pin tube (large)	(2)	501-393
Socket, lamp, with bracket assembly	(2)	500-154
Sponge rubber pad	(1)	840-063

WIRE, SOLDER, TUBING

Description	Qty.	Part No.
Bare wire, 24"	(1)	805-000
Braided wire, 5"	(1)	808-032
Insulated hookup wire:		
2" red	(1)	807-022
3" orange	(7)	807-023
4" yellow	(2)	807-024
5" green	(1)	807-025
6" blue	(2)	807-026
7" violet	(6)	807-027
7" green (heavy)	(1)	807-066
8" gray	(1)	807-028
9" white	(9)	807-029
10" brown	(1)	807-021
12" white/red	(2)	807-[illegible]
14" white/yellow	(3)	807-034
14" Red (heavy)	(1)	807-066
Line cord	(1)	802-004
Shielded cable, 10"	(1)	806-007
Solder 20'	(1)	393-050
Tubing 18"	(1)	812-003